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INFLATION TARGETING IN BRAZIL: WHAT DIFFERENCE DOES A YEAR MAKE?

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Inflation Targeting in Brazil:
What Difference does a Year Make?[1]

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ABSTRACT

The adoption of inflation targeting as a monetary policy strategy in Brazil was a convenient way to replace exchange rate rule by targeted inflation in an effort to anchor inflation expectations.

This paper briefly evaluates the inflation target experience from three viewpoints: reasons behind the success, difficulties regarding forecasting and the risks ahead. It analyses the factors behind the success as well as the way initial doubts and a second round of mistrust were successfully dealt with. It looks at the empirical difficulties to estimate a reliable Demand Function and examines evidence on the persistence of high interest rates as captured by a Taylor rule. It points out to possible signaling problems in the transmission mechanism that might lead to a weakening of the confidence in the strategy in the future. Section 3 draws conclusions on risks that emerged together with favorable outcomes of the first year.

There has been a substantial progress in the overall confidence in monetary policy's management. Inflation targeting has certainly played a relevant role in this gain. However, it looks like we have not got rid of the "**thin ice economy**" riding in the post-Real era, since dependence of inflation on foreign exchange availability is still high. Thus the Brazilian economy is still excessively dependent on international liquidity fluctuations. As it happened in the past six years, because of the combination of the size of interest rate movements with the persistence of effects, a double barrel destructive effect on investment and banking, good scenarios tend to be too good, and bad scenarios are seen as terrible for assets markets.

An appendix note was written by Thomas Wu on the problem of finding a measurement of the output gap for the Brazilian economy.

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INTRODUCTION

One year ago, the adoption of inflation targeting as a strategy for conducting monetary policy in Brazil was seen, above all, as a convenient way to replace the exchange rate rule as a nominal anchor. Convenience stemmed basically from the replacement of expected devaluation by inflation target. The combination of backward-looking inflation expectations with exchange rate overshooting, following the release of the exchange rate rule, could lead to rampant inflation requiring, once again, the drastic use of monetary brakes. After four years of (*ex-post*) real interest rates in the 20% range, fiscal dominance was feared to be an obstacle to the re-habilitation of monetary instrument for the control of inflation. It was hoped that the new exchange rate regime would put an end to the high interest rate – high fiscal deficit nexus which had turned out to be incompatible with the resumption of investors' confidence and economic growth. Actual results turned out to be a lot more than that.

Inflation, measured by IPCA, the consumer price index chosen for the target, went down from an annual rate of 12% in the first half of 1999 to 5% annual rate in the first half of 2000. Expected annual inflation for the 12 months starting on July 1, 1999 went from approximately 10% to 5% in the 12 following months starting on July 1, 2000. Expected GDP annual growth went from -3% at the time of the definition of the strategy to 5% one year later. The nominal exchange rate went from 1.77 per US$ one year ago to 1.80 per US$ and the trade balance from US$ 201 million in June 1999 to US$ 833 million in June 2000.

Table 1
Brazil: Summary data before and after Inflation Targeting

		1ST Q 1999	2ND Q 1999	1ST Q 2000	2ND Q 2000
OUTPUT (t/t-4)		0,72%	-0,17%	3,08%	4,60%
INFLATION (IPCA % annualized)	(actual)	12,03%	4,27%	3,94%	2.67% may
	(expected)	15,87%	18,11%	6,64%	6,93%
NOMINAL INTEREST RATE		38,20%	27,20%	18,90%	19,30%
EXCHANGE RATE (end of period)		1,7220	1,7695	1,7473	1,8000
TRADE BALANCE (US$ millions)		-817,00	201,00	26,00	833,00
PSBR (primary, %GDP)		0,69%	1,55%	3,31%	3.52% april

Source : IBGE, Secex, BCB

Behind the figures, there has been a perceptible improvement in the way the Central Bank communicates its actions and intentions to financial markets, to press, to politicians and to society as a whole, which led to a consistent convergence of markets' expectations towards Central Bank targets. The overall good quality of the quarterly *Inflation Report* is one of the positive factors behind this increased

transparency, but other vehicles, as well, have favored a better transmission of ideas behind monetary policy actions. The result has been a better public perception of the quality of policy-making by Central Bank, and the choice of the monetary policy strategy has a lot to do with it.

This paper briefly evaluates the experience from three viewpoints: reasons behind the success, difficulties regarding forecasting and the risks ahead.

Section 1 analyses the factors behind the success in contrast with the skepticism of a large part of the analysts at the time of inception of the new strategy. It examines how initial doubts were mastered and how the second round of mistrust, which accompanied a gradual but steady sliding of the floating rate in the second half of 1999, was dealt with. **Section 2** looks at the empirical evidence captured by the Phillips curve on the difficulties related to the estimation of a reliable Global Demand Function and examines the persistent effect of high interest rates as captured by a Taylor rule. It points out to a possible signaling problems in the transmission mechanism which might lead to a weakening of the confidence in the strategy in the future. **Section 3** draws conclusions on the risks that emerged together with the favorable outcomes of the first year. Finally, the article includes an **appendix** note by Thomas Wu on the problem of finding a measurement of the output gap for the Brazilian economy.

SECTION 1 — THE CAUSES OF SUCCESS

The decision to formally adopt an inflation targeting strategy following the change in exchange rate policy had three immediate consequences.

First, it was a good show of economic diplomacy. At the time of the inception, the Central Bank team had to face a new phase of negotiations with the IMF, whose officials were, at best, skeptical of inflation targeting as a reasonable commitment. As evidence, we may recall the simple fact that the Net Domestic Assets plus a minimum of foreign exchange reserves were kept as conditionalities. But the move attracted invaluable support from many external partners, not only from multilateral institutions, but also from other countries' monetary authorities. At that time, financial markets' confidence was low and the threat of a systemic crisis was still present in most analysts' scenarios. The choice of an alternative that seemed state-of-the-art policy strategy facilitated communication with other central banks officials. Should government-to-government cooperation be necessary once again, as part of the effort to avoid the eventual return of disruptive default scenario, this could turn out to be a good investment in the effort to bring back markets' confidence.

Secondly, it allowed Central Bank to focus on inflation as explicitly formalized by means of a legal document (a government decree), which announced the inflation target intervals of 8% to 12% for 1999 and 4% to 8% in 2000. At that time, a public demonstration of the government's commitment to inflation control was highly beneficial.

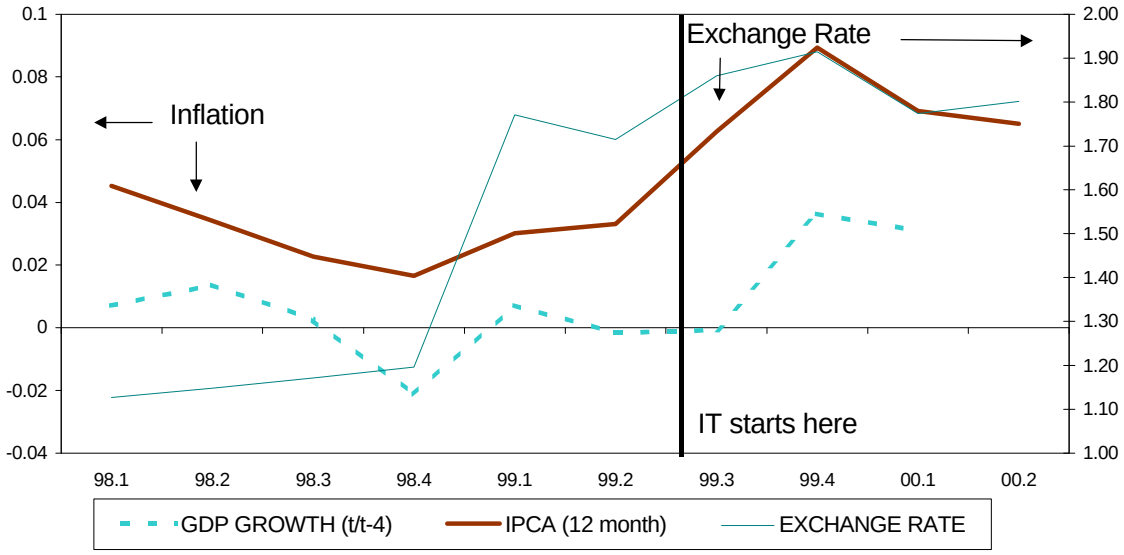
Thirdly, it helped to remove part of the high inflation practices and procedures of monetary policy and public debt management which remained as fossils of the high inflation regime. Part of these remains of high inflation era was the belief that a combination of extraordinarily high interest rates and automatic repurchase rules were essential to induce private wealth managers to maintain their demand for public bonds.

These three facts may be listed as part of the success in the first year. On the other hand, the absorption of the strategy has not been smooth over the last 12 months. Part of the difficulties was present at the time the policy was launched. At the end of the first half of 1999, several conditions recommended extra care in handling the new policy. To name a few:

a) The confidence crisis following devaluation was far from over. Fundamentals of the Brazilian economy were not clearly improving, markets for Brazilian debt were illiquid and fund managers as well as banks' strategists still kept their busy ears on the ground looking high and low for the sounds of the next crisis;
b) Fiscal dominance had been aggravated by the attempts to defend the former exchange rate rules. The fiscal improvement in the short run was obtained by means of expenditure repression, generating pressures that tended to narrow the scope for corrective monetary policy in case of new turbulence. The new strategy was not meant to deal with that. Bad fiscal results could hinder the efficacy of announcements of pre-emptive tightening of monetary policy, which is considered an interesting advantage of inflation targeting as it is perceived by the general public;
c) The fall in terms of trade could suggest more real devaluation was needed in the short run than originally expected, just when a widespread view of an overvalued exchange rate could help damper inflation expectations;
d) Finally, a more general and yet, by and large, unresolved doubt remained. One was entitled to wonder whether the government's commitment to an inflation target strategy would go beyond the initial motivation due to tactical reasons.

Economic growth measured by 4-quarter moving average was visible at the end of the year but the figures around 2% were short of a full-fledged recovery near what could be expected by the President's political support in Congress as desired levels. As may be observed in figure 1, output, measured by quarterly GDP, had stagnated in the first two quarters following the exchange rate fluctuation, at a very low level, since recession had began one year before, at the time of the Russian crisis. Since there is no Congress law or political contract granting the Central Bank a clear mandate either to focus in the targeted rate of inflation, or full freedom in the choice of instruments, poor growth performance could still be a political obstacle to strengthening the institutional setting of monetary policy.

Figure 1
Growth, Consumer Prices and the Exchange Rate
The 1999 results: low growth ahead? (1998.I - 2000.I quarterly data)

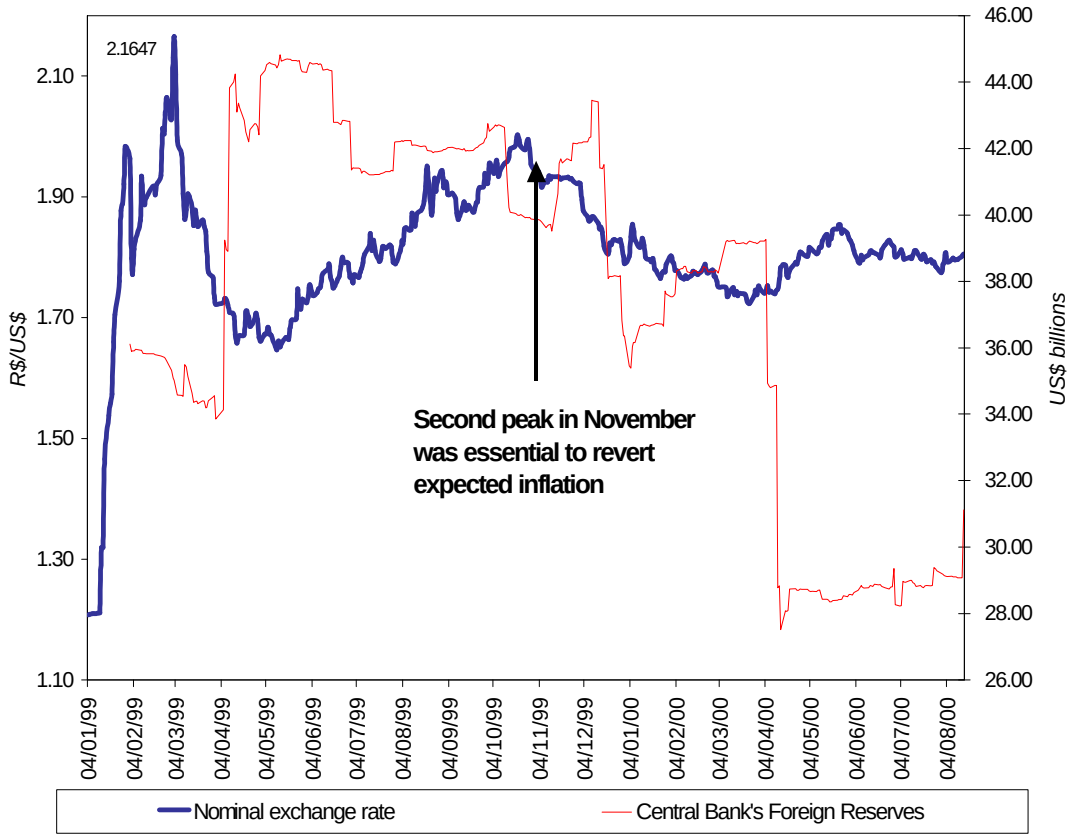


Source : IBGE, BCB

To make matters even worse, in the second half of 1999, the dynamics of the exchange rate and the interest rate in Brazilian economy turned out to be unpleasantly similar to the pre-devaluation period. Figure 2 shows the devaluation trend from May to October. In spite of the fact that interest rates remained high, while expected inflation declined, the exchange market players were led to suspect that further devaluation was forthcoming, as terms of trade continued to slide. US interest rates were still expected to rise for a few quarters, and the level of the Central Banks' foreign exchange reserves was still too small to allow intervention, given the reserve targets set in the agreement with the IMF. This trend was only reverted when, after a favorable mission review prompted by the good performance in the primary surplus, the IMF granted the Central Bank more freedom to use its reserves to intervene in the foreign exchange market. High real interest rates, sliding exchange rate, recession and negative (although improving) trade balance contributed to reinforcing skepticism. At the same time, futures markets, shown in Figure 3 (both for interest rates and exchange rates), reinforced the view of some analysts, among them Gustavo Franco [2000], the former president of the Central Bank and a strong defender of the previous exchange rate sliding mechanism, that devaluation "would not solve the confidence problem". If this were the case, default-signaling interest rates were the only tools to prevent self-fulfilling short-selling rallies on the real. This view was based on a combination of price-elasticity pessimism with an evaluation of declining political support from the President's political allies in Congress to the economic policy.

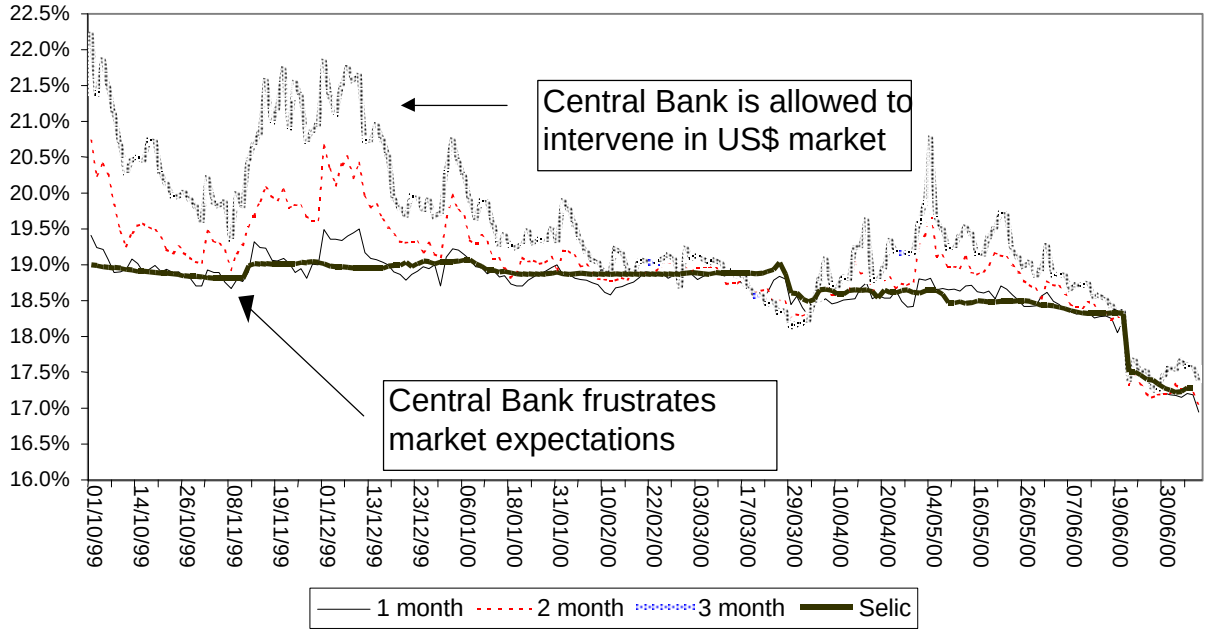
The slow response of the trade balance to devaluation, in spite of the low activity level growth, fueled the pessimism. This state of affairs might signal the dangers of another round of devaluation plus higher interest rates, more recession and worsening of the fiscal balance that would certainly disrupt confidence in the political survival of the new strategy.

Figure 2
The real Floats and Central Bank's Foreign Reserves (R$/US$)



Source : BCB

Figure 3
Interbank rates: spot and futures (oct/99 - jun/00)

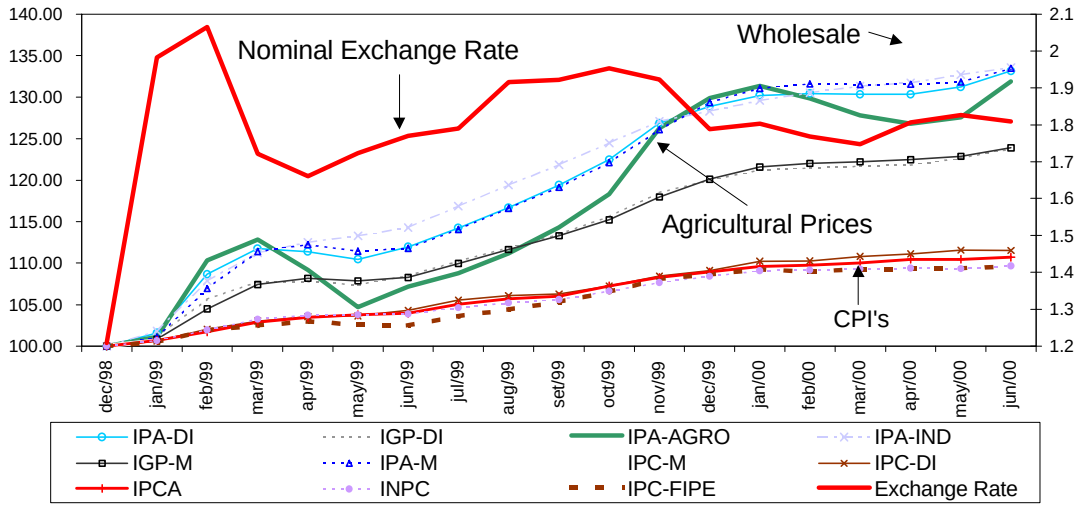


Source : BCB, BM&F

An important battle, however, was won in another front. Besides a significant fall in the volatility of the exchange rate, there was a very fast reduction in the dispersion of the multitude of price indices available to measure Brazilian inflation. The use of a variety of price index to measure inflation is a characteristic inherited from the high inflation experience. Among fifteen price indices that have been used to measure inflation, we selected eleven, to illustrate their relationship with the exchange rate. Figure 4 shows their behavior from January 1999 to June 2000. Following the change in relative prices which reflects the exchange rate devaluation in real terms, the other side of the confidence build-up may be read from the relative behavior of the different indices. The eleven indices, depicted in Figure 4, fall into three categories. **Wholesale** indices, which are the most sensitive to what is happening to the price of tradables and contain many list prices which do not actually correspond to effective transactions; **CPIs**, which reflect the low share of imports in the consumption basket and are loaded with non-tradable services and public tariffs; and the so-called **"general" price index** calculated by Vargas Foundation, defined as averages of wholesale and consumption prices, originally conceived to mimic short run movements of the GDP deflator. Convergence of wholesale to consumer prices and not the opposite is another way to illustrate the ability to float without igniting high inflation mechanisms. Figure 4 shows the behavior of three groups of price indices, the most widely used in inflation analyses in Brazil. One and a half year after devaluation, the extreme lines are wholesale (the high group, reflecting the behavior

of tradable goods) and CPIs (the lowest group, reflecting what was happening to the consumption basket), whereas the mid-range is occupied by the Vargas Foundation's "general indices".

Figure 4
Exchange Rate, Wholesale and Consumer Prices Indices



Source : IBGE, FGV, Fipe, BCB

However, the success of the inflation targeting strategy in bringing about low inflation and lowering expected devaluation, did not make clear the transmission mechanisms at work. In particular, it is hard to tell at this point how much of the slowdown in expected inflation was the result of favorable agricultural prices (at first, export prices, like soybeans and coffee, the same prices that have been responsible for a deceptive behavior of the trade balance); how much could be attributed to the effect of industrial recession in reverting the initial impact of wholesale industrial prices; and how much could be credited to successful management of the exchange rate. Goldfajn (2000) and Goldfajn and Werlang (2000) examined the role of the determinant of the pass-through coefficients and found that several characteristics of the Brazilian economy in 1999 in common with other successful experience helped explain the inflation slowdown after the first hump in the exchange rate.

As to the secondary movement of exchange rate and prices, which occurred in the second half of 1999, however, things seem more complex. The behavior of exchange rate and inflation in the second half of 1999 might be interpreted as the outcome of the Central Bank's decision to frustrate market's expectations (figure 3) and keep interest rates high (in the 19% level) in the fourth quarter of 1999. But in view of the decrease in the output gap in the fourth quarter, one is left with doubts concerning the transmission mechanism.[3]

[3] This point is discussed in Goldfajn (2000).

In particular, the above observations bring back some old questions concerning how different is the new strategy from the exchange-based control of inflation, if only after more freedom to sell reserves the virtuous circle of lower exchange rate, and smaller expected inflation, could finally lead to the reduction of interest rates. Actually, it might be argued that only after a better evaluation of the Brazilian economic policy could be read in the market for Brazilian debt, the Central Bank was cleared to sell reserves and only then to initiate the path which led from the exchange rate to the lowering of interest rates. Brazilian risk measured by the C-bond yield strip (JP Morgan) went down from 15.4% to 13% from October to December. [4]

Finally, it should be mentioned that negative supply shocks have been at work during a good part of the period. The price of oil, for example, doubled and export revenue frustrated expectations concerning the improvement in the trade balance, in part due to unfavorable commodity prices.[5] But a combination of more favorable expectations concerning the exchange rate and the effect of food prices on the consumer price indices in the summer prepared a more confident picture for the first quarter of 2000. Only then could the Central Bank reduce interest rates, with a good help from the fiscal results that prompted another favorable IMF evaluation report.

SECTION 2 — DOUBTS AND THE EVIDENCE FROM QUARTERLY DATA

Two doubts arise from the description of events in the previous section which could be faced with a closer look into the data. The first one regards the links between the response of inflation and the output gap to interest rates. The second one is related to the interest rate responses of the Central Bank to the economic data.

A way to take a closer look was to ignore the short span for which data are available in face of the recent experience with low inflation (and even more recent with inflation targeting). Data limitations notwithstanding, one proceeds to examine the estimates of some basic relations which appear in the Central Bank model, as described in the *Inflation Report* (April 2000).[6]

The links between inflation and output, as well as, between interest rate and output are modeled by a Phillips curve and a Demand Function. One problem hard to solve is related to the output gap measure.

An illustrative summary of the estimated coefficients for the Phillips curve, and a Demand Function (IS) are shown in Tables 2 and 3, where all estimates are from quarterly data in order to make use of the higher frequency possible for GDP series. The Phillips relation, for the 1995.I to 1999.IV does not capture the relevant impact of the narrowing of the output gap on inflation for well-known reasons. At the beginning and at the end of the sample period, inflation was declining while output was recovering. But in both events the reason was not Central Bank's action to stimulate demand but public's confidence that the Central Bank had political support to do its job. This entails a very poor fit, which is presented in two versions. Table 3 presents the results obtained in the estimation of the "backward-looking" Phillips Curve

[4] On what happened to other measures of Brazilian risk, see Garcia (2000) calculations in a comment paper presented in the same seminar.

[5] Terms of trade fell by 7% from January 1999 to January 2000.

[6] A brief review of the model, as described, in the first *Inflation Report* pointing to some consequences of its data limitations was done in Carneiro (2000).

(containing lagged inflation) with 3 different specifications[7]. The first one is a totally unrestricted model and the second imposes long run neutrality. Both results present a positive output elasticity.

If we impose, as restriction, an output elasticity obtained by a simple regression estimate, which appears as .326 in the third column, the lagged inflation coefficient increases. In all cases, the exchange rate pass-through to prices remains in the range .08 to 0.10, a good evidence that the coefficient is robust to the restrictions imposed.

Table 2
Phillips Curve (backward looking specification) for different restrictions

	UNRESTRICTED		NEUTRAL		NEGATIVE	
Variable	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
INFLATION(-1)	0,324	8,0%	0,546	0,6%	0,484	8,0%
INFLATION(-2)	0,376	2,5%	0,365	5,3%	0,102	2,5%
OUTPUT GAP*(-1)	0,087	35,2%	0,149	16,0%	**-0,326**	**-**
EXCHANGE RATE	0,082	0,9%	**0,089**	-	0,104	0,9%
R^2	67,0%		53,8%		29,4%	
Adjusted R^2	61,5%		48,9%		22,0%	
Durbin Watson	2,259		1,980		2,373	
Akaike IC	-5,955		-5,709		-5,286	
Schwarz IC	-5,756		-5,560		-5,138	
F-statistic	12,168		11,041		3,961	
Prob(F-statistic)	0,0%		0,1%		3,6%	

*Linear trend using data since 92.I

Dependent variable: Inflation

Adjusted sample: 1995.I - 2000.I

Attempts to estimate an IS curve from quarterly data for the short period after stabilization have not been successful, even if we are willing to tolerate a disastrous loss of degrees of freedom. Better results may be obtained with a longer series for quarterly GDP but several structural breaks have to be dealt with, and the sensitivity of the output gap coefficient to how we deal with the breaks and to the choice of filter for definition of "normal output" poses some problems to the interpretation of the coefficients, which are beyond the scope of these notes and are analyzed elsewhere.[8] Table 4 contains some illustrative estimates for the IS curve. The first one follows the specification in the Bogdanski-Tombini-Werlang paper. It has a poor fit, not exactly a surprise in view of the non-significant real interest coefficient, but when seasonality is taken care of by mean of seasonal dummies, a better fit is obtained, and the real interest rate coefficient becomes significant. Two other regression estimates have been added, which restrict the NFSP coefficient to be -1, but this leads to a poorer fit. But it

[7] The results for a "forward looking" Phillips Curve, containing an expected inflation variable, is presented in the appendix.

[8] Carneiro e Wu (2000), mimeo.

should be noted that in all exercises the coefficient of the lagged interest rate remains remarkably stable.

A better result estimate is available for a Taylor Rule, what comes as a surprise if we consider that interest rate movements have, by and large, been determined by external events and we have not included any external variable thereby allowing the exchange rate to capture the impacts, even when the exchange rate was bound within a narrow band. Table 3 presents illustrative results.

A high degree of inertia in the interest rate rule is noted, as expected, suggesting that once the interest rate is increased, the recessive impact is to be felt for a long time due to difficulties in finding a reasonable way to lower interest rate without sending inadequate optimistic signals to asset holders. On the other hand, the fiscal bruises and the investors' scars have been unusually severe but have not been included in the demand curve, so one may tend to underestimate the indirect fiscal impact of the interest rate shocks in such models which use the primary surplus as the fiscal variable in the IS function.

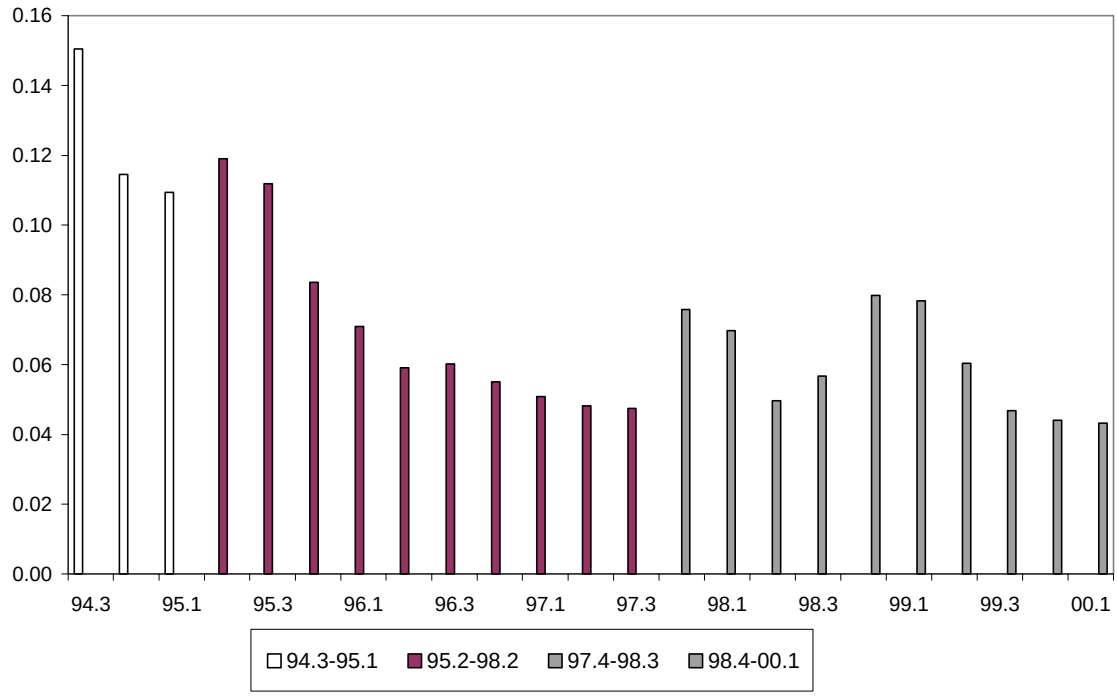
Table 3
Different specifications for the IS curve

	WITHOUT *DUMMIES*		**UNRESTRICTED**		**PSBR RESTRICTED**		**PSBR OMMITED**	
Variable	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
CONSTANT	-0,029	20,5%	-0,008	55,3%	-0,018	36,8%	-0,005	70,5%
OUTPUT GAP(-1)	0,365	15,3%	0,647	1,1%	0,689	6,0%	0,636	1,3%
OUTPUT GAP(-2)	-0,081	76,1%	0,097	69,0%	0,042	91,0%	0,112	65,0%
REAL INTEREST RATE(-1)	0,527	27,0%	0,517	4,0%	0,641	8,6%	0,483	5,3%
PSBR(-1)	-0,341	36,6%	-0,215	23,7%	**-1,000**	-	-	-
DUMMY1	-	-	0,012	22,8%	0,005	71,2%	0,014	17,1%
DUMMY2	-	-	-0,054	0,1%	-0,057	0,7%	-0,053	0,1%
DUMMY3	-	-	-0,025	6,4%	-0,023	24,9%	-0,026	6,2%
R^2	25,0%		86,8%		66,0%		85,2%	
Adjusted R^2	6,3%		79,7%		51,4%		78,9%	
Durbin Watson	1,712		2,296		0,971		2,157	
Akaike IC	-4,057		-5,508		-4,657		-5,491	
Schwarz IC	-3,809		-5,110		-4,309		-5,143	
F-statistic	1,334		12,198		4,525		13,459	
Prob(F-statistic)	30,0%		0,0%		0,9%		0,0%	

Dependent variable: Output Gap (Linear Trend, Data since 1992)

Adjusted sample: 1995.I - 2000.I

Figure 5
The shocks persistence: Selic interest rate evolution (log of)



Source : BCB

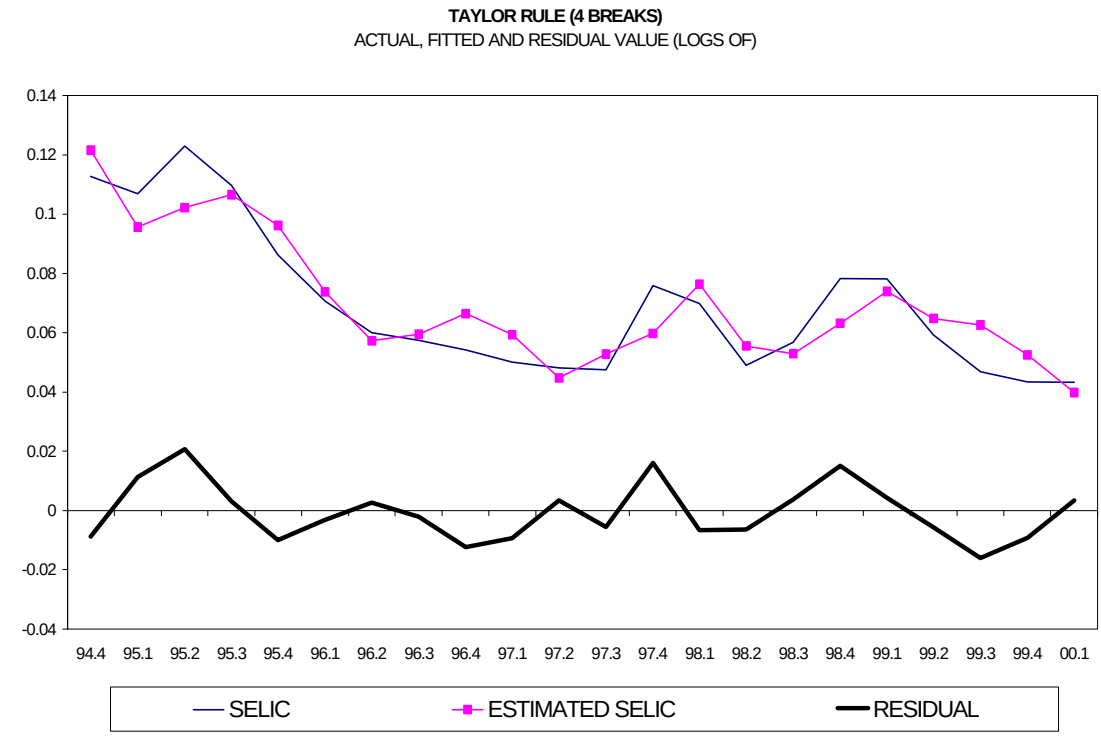
One explanation found for the difficulties may have relation with persistence in the shocks. As mentioned earlier, if the interest rate changes have been dominantly motivated by external shocks under an exchange rate rule regime, it should be no surprise that it has reacted so little to the output gap variables. Is it possible to find an evidence of this persistence? Quarterly data for the Selic rate are shown in Figure 5, and suggest that a good deal of persistence is present in the interest rate. Has inflation targeting decreased persistence? Tables 4 and 5 may help us find an answer. Regressions of the Taylor Rule were run with coefficient dummies for the different post-shock periods (4 in the first one, 3 in the second one, where the first two periods considered in Figure 5 have been consolidated).

Table 4
The Persistence of Shocks: estimation of a Taylor Rule

	ONE PERIOD		4 BREAKS	
Variable	**Coefficient**	**P-value**	**Coefficient**	**P-value**
CONSTANT	0,016	2,7%	0,006	56,1%
INTEREST RATE(-1) 94.III - 00.I	0,694	0,0%	-	-
INTEREST RATE(-1) 94.III - 95.I	-	-	0,708	0,0%
INTEREST RATE(-1) 95.II - 97.III	-	-	0,776	0,0%
INTEREST RATE(-1) 97.IV - 98.III	-	-	0,887	0,0%
INTEREST RATE(-1) 98.IV - 00.I	-	-	0,969	0,0%
INFLATION DEVIATION*	0,208	41,6%	0,345	25,4%
OUTPUT GAP(-1)	-0,171	5,5%	-0,285	1,9%
R^2	81,0%		83,9%	
Adjusted R^2	77,9%		77,8%	
Durbin Watson	1,388		1,498	
Akaike IC	-5,925		-5,830	
Schwarz IC	-5,728		-5,485	
F-statistic	26,923		13,863	
Prob(F-statistic)	0,0%		0,0%	

* INFLATION - EXPECTED INFLATION
Dependent Variable: Interest Rate (Selic)
Adjusted sample : 1994.IV - 2000.I

Figure 6
Nominal Interest Rate (Selic)



Source : BCB

The conclusion is that the lagged interest coefficient increased steadily in each shock from .708 to .969, from the Mexican Crisis to the Brazilian Crisis with a gap

coefficient ever higher and with smaller variance. The results are practically the same if we use three instead of four periods. Looking at the residuals of the last regression, there is no sign that inflation targeting may have decreased interest rate persistence in the first year of experience. And this is certainly an obstacle to overcome.

SECTION 3 — CONCLUSIONS

There has been a substantial progress in the overall confidence in the management of monetary policy. Inflation targeting has certainly played a relevant role in this gain. However, it looks like we have not got rid of the "**thin ice economy**" riding in the post-Real era, since dependence of inflation on foreign exchange availability is still high. Thus the Brazilian economy is still excessively dependent on the fluctuations of international liquidity. As it happened in the past six years, because of the combination of the size of interest rate movements with the persistence of effects, a double barrel destructive effect on investment and banking, good scenarios tend to be too good, and bad scenarios are seen as terrible for assets markets.

Yet, we seem to know a lot less than we would like to about the impact of interest rate on activity level, which is crucial to clarify an important factor of investors' confidence, namely how high interest rates have to be raised when a slowdown of the economy is necessary. In the recent crises, which are the immediate source for data variation, the experience has been disruptive. This means that if a slowdown of economic output is to be obtained by monetary means, investors are entitled to fear that this may require an interest shock which may prompt a banking crisis or a moratorium in the public debt, with all their destabilizing effects on financial markets. This should be a part of the investors' risk calculations when the purchase of Brazilian debt instruments is considered.

If we believe that a long "inertia" will be present in the downward path of interest, as suggested by the empirical results of Section 3, we find that inflation targeting has a long way to go before we may trust the strategy's effect on the stability. One important task is thus to find a regime for the interest rate – output response nexus which is credible and do not require bad news generation or destructive scenarios. But in the transition, other policy measures are desirable in order to prevent the present experiment from being prematurely aborted on account of excessive political abrasion.

In the present situation, the impulse-response patterns implicit in such coefficients suggest a hysterical pattern. That is, a system in which both the reaction of the Central Bank to bad outcomes and the reaction of the economy to Central Bank's action may be too strong and therefore surprises, up or down, may play a de-stabilizing role.

Part of this phenomenon may be attributed to the roles financial intermediaries have been playing in the Brazilian economy after stabilization. Until a "normal" financial system is at work, that is, one in which the credit and the asset markets effects are apt to be the main channels for the transmission of monetary impulses to the economy, the exchange rate channel seems to be playing a more important role than the usual measures of the degree of opening of the economy, such as the share of imports, as total expenditure would suggest.

In the present situation, this means that exchange rate movements tend to reflect more the reasons behind capital flows (which tend to be more volatile than could be justified by fundamentals) than overall sustainability of the current account. Two consequences are to be noted. First, fluctuations in the exchange rate may aggravate adverse external shocks, an argument that is always present when the degree of financial opening of the economy is been reviewed. The second one is that the political support to pursuit fundamentals improvement tends to be fragile. Two policy consequences should be examined. The first one is the high priority to the organizational and legislative initiatives to reinforce the credibility of credit markets so that competition and a better regulation of responsibilities of creditor and debtor may favor the lengthening of private debt at reasonable costs and smaller default risk. The second one is that a high level of the Central Bank's foreign exchange reserves should be desired as a means to compensate excessive fluctuation.

Only very recently competition among banks to supply credit began to have an effect on spreads. Given the risk of self-fulfilling pessimism in exchange rate markets, the monetary policy framework for the next years will have to find not only smoother ways to react to adverse shocks, but will have to prevent boom-and-bust credit cycles that might fuel either a speculative investment boom or a panic run on Brazilian currency.

DDC

APPENDIX 1: CONSTRUCTING THE OUTPUT GAP SERIES

The endogenous activity level variable in an IT model is the output gap. Although some countries have an official data for the output gap, the official activity level measurement in Brazil is a quarterly GDP index. So the first step before trying to estimate the elasticities involved in output, inflation and interest rates is to construct an appropriate output gap measurement. Although the concept of output gap is a well-defined one in economic theory, there is a vast literature on econometrical methodologies to construct it.

The most usual methodologies for constructing a potential GDP series from a GDP index are the Hodrick-Prescott filter, the linear trend, the Kalman filter and estimates of production functions. Bogdanski, Tombini and Werlang (2000) reports that for the Brazilian quarterly GDP data the best results are obtained using the linear trend and the Hodrick-Prescott filter. Although the results are very similar, there are some differences to be considered. By definition the linear trend implies a constant potential output growth, which means that we can recover output growth estimates based on output gap forecasted by our IT model. On the other hand, for the HP filter the potential output growth is higher in recoveries and smaller in contractions, which implies a smoother output gap series.

It is also known that, despite the chosen methodology, the construction of the potential output series is also sensitive to the sample span. We consider three different time span, they all end in 2000.1 (most recent data available) but differ in the starting date. The first time span considered starts at 1994.3, which means that only the post-Real Plan data is considered. But one must not forget that the output trend is a long term phenomenon, so it would be more reasonable to choose the largest span available. The longest time series for the quarterly GDP starts in 1990. There is also another series that starts in 1980, but since it was calculated in another methodology, it will not be considered. So our second choice of time span starts at 1990.1. One historical peculiarity about the 1990 and 1991 years lead us to a third time span. The Collor Plan has driven our economy into a deep recession, perhaps the worst of the nineties. One may fear that the inclusion of this period data would affect the position of the potential output trend, since it represents almost 20% of the number of observations. Then, our third time span considered starts at 1992.1.

We constructed the output gap series using two methodologies, the linear trend and the Hodrick-Prescott filter, and considering for each methodology three different time span, 1990.1-2000.1, 1992.1-2000.1 and 1994.3-2000.1. Results are shown in Figure A.1 (dotted line). Because of the strong seasonal pattern present in the series, quarterly dummy variables are included. The full line in each graph in Figure A.1 is the output gap seasonally adjusted by dummy variables.

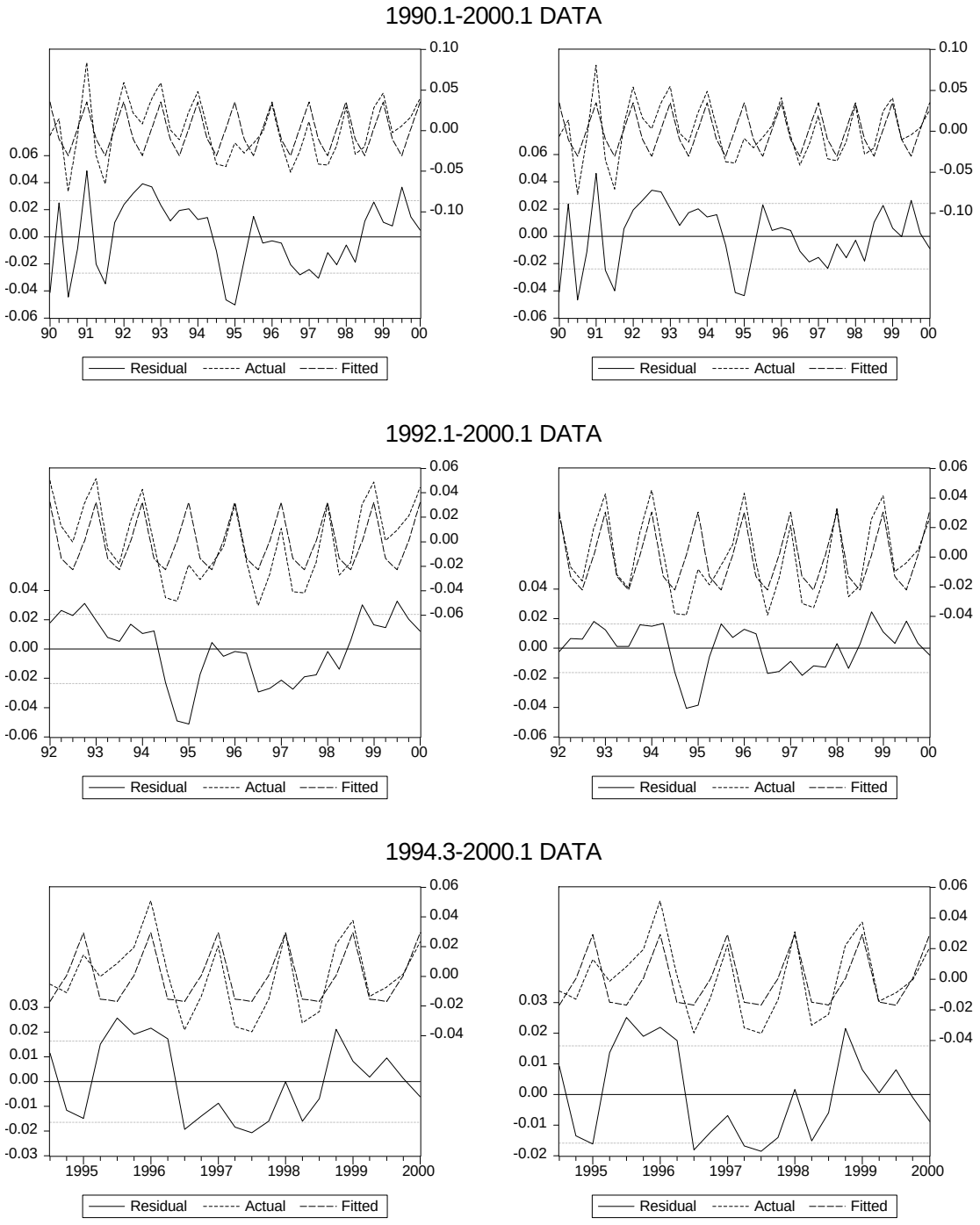
Before choosing one of the six output gap series constructed, we must define what we mean by “best”. A reasonable criteria is to define best methodology as the one which creates an output gap series that matches our historical economic perception of the period being analyzed. This means that we can rule out methodologies that constructs positive output gaps in periods we believe the economy was overheated and negative output gaps in periods we believe the activity level was low.

In Figure A.1 we can notice that the Hodrick-Prescott filter, for every time span chosen, accuses a warm activity level for the first quarter of 2000, warm enough

to justify higher interest rates if one have in mind any kind of Taylor Rule. Since this was not the perception for that period, we believe the Hodrick-Prescott filter is not appropriate. The same happens for the linear trend if we consider the time span 1994.3-2000.1. So we are left with the linear trend and two time spans, 1990.1-2000.1 or 1992.1-2000.1. Notice that for the largest time span, the 92/93 activity level is too depressed. So the output gap series that best describes our historical economic perception of the period involved is constructed with a linear trend and considering data since the first quarter of 1992.

Figure A.1

LINEAR TREND	HODRICK-PRESCOTT FILTER



APPENDIX 1.1: Different output gap series seasonally adjusted with dummy variables

One relevant question after this exercise is to ask how sensitive are our estimates to the choice of the methodology. The previous analysis made can be viewed somehow as a "calibration" of the level of the potential output, or choosing where to cross the zero output gap line. If all the six series have very similar movements differing only in their position in relation to the origin, the elasticities estimates should be robust to the choice of methodology. The estimated elasticities are the angular coefficients of linear projections of the output gap on, say, inflation or on interest rate. The linear coefficient of this linear projection is the one that should be most affected. Table A.1 illustrates this point reporting estimates of a simple IS curve controlled with dummies variables. The output gap elasticity with respect to the real interest rate calculated for the six different series remains in a range of 0.477 to 0.534.

Table A.1

DEPENDENT VARIABLE: OUTPUT GAP (LINEAR TREND WITH DIFFERENT TIME SPAN)
ADJUSTED SAMPLE: 1995.I - 2000.I

	DATA SINCE 1990.I		DATA SINCE 1992.I		DATA SINCE 1994.III	
Variable	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
CONSTANT	-0.009	48.5%	-0.008	55.3%	-0.015	21.2%
OUTPUT GAP(-1)	0.629	1.2%	0.647	1.1%	0.484	3.9%
OUTPUT GAP(-2)	0.072	76.4%	0.097	69.0%	-0.002	99.1%
REAL INTEREST RATE(-1)	0.511	3.9%	0.517	4.0%	0.534	1.8%
PSBR	-0.219	22.3%	-0.215	23.7%	-0.244	14.2%
DUMMY1	0.012	21.2%	0.012	22.8%	0.015	9.8%
DUMMY2	-0.052	0.1%	-0.054	0.1%	-0.042	0.3%
DUMMY3	-0.024	7.4%	-0.025	6.4%	-0.019	12.7%
R^2	86.2%		86.8%		85.6%	
Adjusted R^2	78.7%		79.7%		77.9%	
Durbin Watson	2.300		2.296		2.220	
Akaike IC	-5.538		-5.508		-5.729	
Schwarz IC	-5.140		-5.110		-5.331	
F-statistic	11.553		12.198		11.063	
Prob(F-statistic)	0.0%		0.0%		0.0%	

DEPENDENT VARIABLE: OUTPUT GAP (HODRICK-PRESCOTT FILTER WITH DIFFERENT TIME SPAN)
ADJUSTED SAMPLE: 1995.I - 2000.I

	DATA SINCE 1990.I		DATA SINCE 1992.I		DATA SINCE 1994.III	
Variable	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
CONSTANT	-0.012	33.5%	-0.011	36.0%	-0.015	21.5%
OUTPUT GAP(-1)	0.524	2.6%	0.517	2.8%	0.468	4.7%
OUTPUT GAP(-2)	-0.004	98.8%	-0.006	97.8%	-0.015	94.9%
REAL INTEREST RATE(-1)	0.480	3.5%	0.477	3.5%	0.525	1.9%
PSBR	-0.149	36.4%	-0.138	40.1%	-0.207	20.4%
DUMMY1	0.014	12.4%	0.014	11.9%	0.016	9.1%
DUMMY2	-0.045	0.2%	-0.045	0.2%	-0.041	0.4%
DUMMY3	-0.020	10.7%	-0.020	10.8%	-0.018	14.2%
R^2	84.9%		84.8%		85.1%	
Adjusted R^2	76.8%		76.6%		77.1%	
Durbin Watson	2.358		2.364		2.190	
Akaike IC	-5.720		-5.736		-5.740	
Schwarz IC	-5.323		-5.338		-5.342	
F-statistic	10.433		10.353		10.632	
Prob(F-statistic)	0.0%		0.0%		0.0%	

If the IT model were constructed in first differences, which means that we were interested only in the direction of the changes of the endogenous variables, then this whole exercise would not matter. But since we know that monetary policy targets are set in level, a positive or negative output gap can mean 1% or 2% percent difference in inflation via a Phillips Curve and 1% or 2% higher interest rates via any

kind of Taylor Rule. So the appropriate calibration of the zero output gap level can make the difference between reaching or not the targeted inflation or even between growth and stagnation.

APPENDIX 2: FORWARD LOOKING PHILLIPS CURVE

The lack of a survey on market expectations on the inflation rate since the beginning of the Real Plan imposes a major problem on the estimation of a Forward Looking Phillips Curve. In Table A.2 we present the estimates with different restrictions considering as the expected inflation the fitted value of a linear projection of inflation on the available information, including lagged values of the exchange rate. Once again, negativity restriction on the output gap elasticity is made necessary. When this restriction is imposed, the exchange rate pass-through to inflation obtained is 0.085, which falls in the range presented in Table 3.

Table A.2

DEPENDENT VARIABLE: INFLATION (PHILLIPS CURVE *FORWARD LOOKING*)

	UNRESTRICTED		**NEUTRAL**		**NEGATIVE**	
Variable	**Coefficient**	**P-value**	**Coefficient**	**P-value**	**Coefficient**	**P-value**
INFLATION(-1)	0.390	1.7%	0.411	0.6%	0.423	5.5%
EXPECTED INFLATION(1)	0.602	2.1%	0.536	0.1%	0.292	36.6%
OUTPUT GAP(-1)	0.076	42.4%	0.060	45.8%	**-0.326**	**-**
EXCHANGE RATE	0.050	12.4%	**0.052**	-	0.085	5.2%
R^2	74.8%		74.7%		48.5%	
Adjusted R^2	70.6%		72.0%		43.1%	
Durbin Watson	2.441		2.519		2.464	
Akaike IC	-5.971		-5.339		-5.345	
Schwarz IC	-5.772		-5.240		-5.196	
F-statistic	17.849		15.262		8.942	
Prob(F-statistic)	0.0%		0.1%		0.2%	

APPENDIX 3: GRANGER-CAUSALITY TESTS

Table A.3

Pairwise Granger Causality Tests
Sample: 1994:3 1999:4
Lags: 4

Null Hypothesis:	Obs	F-Stat.	P-value
OUTPUT GAP does not Granger Cause PRICES	18	3.378	0.059
PRICES does not Granger Cause OUTPUT GAP		0.778	0.566
INTEREST RATE does not Granger Cause PRICES	18	0.813	0.547
PRICES does not Granger Cause INTEREST RATE		0.154	0.956
PSBR does not Granger Cause PRICES	18	2.187	0.151
PRICES does not Granger Cause PSBR		0.754	0.579
EXCHANGE RATE does not Granger Cause PRICES	17	8.165	0.006
PRICES does not Granger Cause EXCHANGE RATE		0.861	0.526
INTEREST RATE does not Granger Cause OUTPUT GAP	18	4.849	0.023
OUTPUT GAP does not Granger Cause INTEREST RATE		3.196	0.068
PSBR does not Granger Cause OUTPUT GAP	18	0.550	0.703
OUTPUT GAP does not Granger Cause PSBR		2.294	0.138
EXCHANGE RATE does not Granger Cause OUTPUT GAP	17	0.454	0.767
OUTPUT GAP does not Granger Cause EXCHANGE RATE		0.595	0.676
PSBR does not Granger Cause INTEREST RATE	18	0.295	0.873
INTEREST RATE does not Granger Cause PSBR		2.077	0.166
EXCHANGE RATE does not Granger Cause INTEREST RATE	17	1.844	0.213
INTEREST RATE does not Granger Cause EXCHANGE RATE		0.995	0.462
EXCHANGE RATE does not Granger Cause PSBR	17	1.511	0.286
PSBR does not Granger Cause EXCHANGE RATE		0.905	0.504

Granger causality tests were run on the data to obtain evidence on the IT model's transmission mechanisms. We have good evidence that INTEREST RATE Granger causes OUTPUT GAP, followed by evidence that OUTPUT GAP Granger causes PRICES. We have also strong evidence that EXCHANGE RATE causes PRICES.

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